# SCIENCE:

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JOHN MICHELS, Editor.

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## NOTICE TO SUBSCRIBERS.

We consider it due to those subscribers who have favored us with their subscriptions, previous to the publication of our club rates, that they should have the privileges of the list. They can therefore send us subscriptions for any or all of the publications named at the reduced double rates, less $4, the subscription price of "SCIENCE."

Since the publication of the club rates last week, we have received rates from the proprietor of *The American Journal of Science and Arts*, the terms of which are $6 a year. The club rate with SCIENCE will be $8.50 per annum.

THE Report of the United States Commissioner of Education, for the year 1878, has just reached us, and as but twenty days intervenes before 1881 will make its debut, the first impression on opening the volume is that it is already somewhat out of date. We believe that the cause of delay in printing this and other reports is attributable to the slow action of Congress in making the appropriations for printing, and we trust that in future the Commissioner may have facilities for publishing his report at an earlier date, as both its value and interest are much diminished by its being circulated two years after the facts recorded have transpired.

Thus, the first line of the report lamenting the existence of the financial depression, is read with impatience in these booming times. We congratulate the Commissioner on the fact that "the assault on the bulwarks of society, by ignorant, unfortunate or unprincipled persons," has not been so destructive as was anticipated. Society at least survives, notwithstanding the action of those "who would modify our present freedom of conscience, and of those who would establish a distinction of classes with a view to a permanent aristrocracy, or practice some form of destructive communism." These gloomy political forebodings, which hardly appear to come within the range of Educational Statistics (in the absence of the catastrophy indicated), may now be read without alarm, and we feel tempted to suggest the propriety of publishing official prophetic utterances, while anticipations may yet "lend enchantment to the view."

The Commissioner of Education makes a strong appeal to public opinion, that Congress may be influenced to place more adequate means at his disposal to carry out the duties of his office. "Called upon by thoughtful educators in anticipation of perils, from which it was hoped he might afford relief or safety, and in the midst of ignorance on the one hand and indifference or opposition on the other," he complains that he is not furnished with either the quarters, the assistants, or the money necessary to do the work required.

To enable the Bureau of Education to perform its national functions satisfactorily, without the co-operation of volunteer aid, which has in the past enabled it to accumulate information, the Commissioner wishes Congress to comply with six requests, which he makes in the following order: *First*, a sufficent force of competent and trained men and women; *Second*, proper quarters; *Third*, a library having everything printed on the subject of education; *Fourth*, a collection of educational appliances, the character of which is described; *Fifth*, appropriate means of receiving and collecting information in regard to educational systems, institutions and methods; *Sixth*, means to arrange all this information, publish it, or communicate it to the educators of the country.

We fear the Commissioner has somewhat weakened his case by showing his ability to present so ample a report with the means already at his command, but we trust that any substantial aid that he really stands in need of will not be withheld. The concessions he calls for appear quite reasonable and essential to his office, and his success in obtaining them will probably be controlled by his ability to prove that such is the case.

This Journal, representing one of the highest branches of education, naturally desires that a National Bureau, for collecting educational statistics, should be properly supported by the nation, so that no lack of means at the command of the Commissioner should justify an inadequate administration of the office.

We have made a few selections from this report, chiefly relating to scientific schools, and a few facts that appear of special interest. These will be found in another column.

## THE EPSOM MINERAL WATER OF MISSOURI.

BY PROF. CHAS. E. WAIT.

**A shallow well recently sunk within three miles of this place yields a mineral water which promises to be a valuable addition to the list of saline purgatives. A sample of this water was taken**

October 23, and was examined, with the following interesting results:

ANALYSIS.

Temperature.... = 58° F.
Specific Gravity, = 1.006819.

| SOLIDS. | GRAINS PER GALLON. |
|---|---|
| Sodic Carbonate | 4.160 |
| Calcic Carbonate | 23.616 |
| Magnesic Carbonate | .569 |
| Ferrous Carb nate | 081 |
| Sodic Chloride | 27.312 |
| Sodic Sulphate | 4.844 |
| Potassic Sulphate | 9.730 |
| Calcic Sulphate | 67.231 |
| Baric Sulphate | trace. |
| Magnesic Sulphate | 264.505 |
| Aluminic Oxide | .034 |
| Ammonia | trace. |
| Silicic Oxide | .038 |
| Organic Matters | 1.178 |
| | 403 298 |

| GASES. | CUBIC INCHES PER GALLON. |
|---|---|
| Carbonic Anhydride | 23.178 |
| Nitrogen | 4 330 |
| Oxygen | 1.493 |
| Hydrogen Sulphide | trace. |
| | 29.001 |

Not enough thus far is known of the water to enable me to present any reliable data concerning its therapeutic value; but physicians here and elsewhere, who have tried it, pronounce it an exceedingly valuable water.

MISSOURI SCHOOL OF MINES,
ROLLA, *November* 26, 1880.

## THE ANTHROPOLOGICAL SOCIETY.

The Anthropological Society, of Washington, met on Tuesday evening, December 7, in the Smithsonian Institution, Professor Otis T. Mason in the chair. The following papers were announced: "Superstitions," by Mr. A. S. Gatschet, and "Savage and Civilized Orthoepy," by Professor Lester F. Ward. Mr. Gatschet, after giving the definitions of different authors and finding them too narrow, ascribed to superstition the following meaning: A belief in a physical power operating either within or without us, acting miraculously to affect our bodies or our minds, and which can be influenced to grant our requests. The word is derived from *super stare*, to survive. There are two kinds of superstition, the religious, relating to the world of spirits, and that of the physical nature, relating to all the phenomena of sense. It is hard to draw the line where religion ends and superstition begins, but the latter most generally represents the forces of nature as deified or anthropomorphic. The existence of superstition is manifested in names of gods, those of the American gods representing the sun, moon, and forces of nature.

Symbolism plays an important part in this connection, as well as the cultus of dreams, augurytaboo, omens and prognostics; such as cheiromancy and fortune-telling, hunting and fishing signs, witchcraft, medical jetishes, meteoric showers, comets, amulitism, etc.

The causes of superstition are mental inertia and ignorance of the real causes of things, coupled with the insatiable desire to account for phenomena. Isolation is also a very fruitful source of these beliefs. They are valuable to us only when we can trace their origin; then they lead to a knowledge of savage psychology, and are of very great use. The author of the paper illustrated the various points taken up by many myths and superstitions from our Indians and other sources.

Mr. Gatschet, having spent several years in personal contact with the aboriginal mind, is very competent to form an opinion as to the rationale of our Indian superstitions.

Dr. Morgan took the ground that superstition is natural to our race, having found in his practice that few of his patients were free from it.

Mr. Mason drew attention to the worthlessness of these innumerable stories unless they are brought together in classes, so that out of them some clue may be found to their origin. Every intelligent mortal passes his life between two worlds, the known and the unknown. Between these two is a border land, where superstition dwells. Its inhabitants are different for different individuals or tribes, and vary with our growing years. For Mr. Haeckel it is peopled with atom-souls, and, for the savage, with the concrete souls of things.

## NEW YORK ACADEMY OF SCIENCES.

### THE MAN OF THE CAVES.

BY PROFESSOR W. BOYD DAWKINS, F.R.S., Owens College, England.*

The questions which we have to put to ourselves are these: At what time in the geological history of the earth did man appear? and what manner of man was he? The answers to these questions are to be found in the recent discoveries, in the deposits of ancient rivers, and in the accumulations in caverns, which have been explored in the Old World during the last 60 years. Inquiry into the antiquity of man falls within well defined limits in point of time. Since there were no living species of the higher mammalia in the earlier stages of the tertiary period, the Eocene and the Miocene, it is hopeless to look for a highly specialized being such as man, nor in the succeeding Pliocene is it likely that he will be discovered, since but very few of the living, higher mammalian forms were then on the earth. When we examine the next stage, or Pleistocene, a period characterized by the presence of numerous living mammalia in both the New and Old Worlds, the field is fairly opened before us for our inquiry. The conditions of life at that time were precisely those in which man would be expected to exist, and it will be my object to put before you the evidence as to the earliest man of which we have any certain knowledge.

In the Pleistocene period the physical conditions of Europe were wholly unlike those which it now presents. The sea-board of the Atlantic reached to the 100-fathom line, or 100 miles to the west of the coast of Ireland. The British Isles formed a part of the Continent of Europe, and the area of the North Sea formed a shallow valley, abounding in mammalia of various kinds. The Mediterranean Sea also was much smaller than it is now, a land barrier extending North into Spain by the way of Gibraltar, and another passing in the direction of Malta, Sicily, and Italy, while what is now the bed of the Adriatic Sea was dry land, and most of the islands in the Ægean Sea were the tops of ranges of hills overlooking rich and fertile valleys. The living mammals appearing on this tract of land consisted of Southern species—the hippopotamus, spotted hyena and others—which ranged as far north as Yorkshire.

A second division is composed of the Northern animals, such as the reindeer, the musk sheep, and the like, which ranged as far to the South as the Alps and the Pyrenees, while yet a third division, such as the stag, bison, and horse, ranged over nearly the whole of Middle and Southern Europe. The remains of these animals, lying side by side with extinct species, such as the mammoth and the woolly rhinoceros, characterise the Pleistocene deposits of Europe. There were great climatal changes in Europe during the Pleistocene age. The temperature gradually lowered, and in the North large masses of ice spread over certain regions. When the temperature was lowest the Northern animals advanced furthest to the South, and when the temperature was warmest the Southern animals advanced furthest to the North, and from the intimate association of their remains in ancient river deposits and in caves may be inferred that the Winters were very cold and the Summers very warm

* Lecture delivered before the Academy, December 6, 1880.

Besides the seasonal variations, there was a gradual lowering of the temperature which produced the phenomena known as Glacial, and which characterized the Glacial period, as it is generally termed. The appearance of man at this stage may be conveniently studied from the point of view of the river deposits of Crayford, in Kent, a place remarkable for the large number of mammoths, bisons and horses, which have there been exhumed. Numerous flint splinters of unmistakeable human workmanship were discovered in the Spring of the present year, under conditions which indicated the exact spot on which an ancient hunter sat and chipped them, and these chips being so little disturbed that it was found possible to put together several large masses, and to restore some of the original nodules from which the implements were made. In one case I was fortunate enough to discover an implement rudely chipped all around which indicated that the primeval hunter of the mammoths, bisons and horses of that neighborhood was in the same state of culture as the man who hunted reindeer in the valley of the Thames in the next or the latest stage of the Pleistocene period. The river valleys of the south of England are covered with sheets of gravel termed river drift, and these contain vast numbers of reindeer, as well as bisons and horses, and were accumulated at a time when the climate was severe. In these, numerous implements were discovered, extending from Peterborough, in the north, as far as the channel. Similar implements are also met with in France, and occur in Spain, Italy, Greece, Northern Africa, and Egypt; they also occur in Asia Minor, and have been found throughout the peninsula of India. They indicate a primeval condition of savagery from which mankind has emerged, which was uniform over the whole of this area. It is not a little strange that the river-drift hunter should have used implements of precisely the same shape and material in the Indian jungles, in the forest-clad shores of the Mediterranean, and in the wilds of Middle and Northern Europe. No human remains assignable to this age are sufficiently perfect to allow of our passing opinion of man's physique, but they tell us that he was a man and not a "missing link." The researches of Dr. Abbott on the river gravels of Trenton appear to establish the fact that the river-drift man was an inhabitant of America during the time when the mammoth was living in the valley of the Delaware. The paleolithic implements of the ate Pleistocene river beds are rude and simple, although they show a considerable advance from the simple flake, which is the only trace left by the man of the middle Pleistocene. As regards the man of that period, it is probable that the plateau of Central Asia was the centre from which the race diverged.

On the bottom of the caves of Creswell, in Yorkshire, were found river-drift implements in association with vast numbers of gnawed bones of both living and extinct animals, brought in by hyenas, while in the upper portions were found implements of a higher type, composed of flint and carved bone. Among these was the incised figure of a horse; these imply a higher type than that of the river-drift, and belong to a state of culture known as that of the cave man. It seems to be unquestionable that the cave men were preceded in their habitations by the river-drift men, in some places at least, and that of the two sets of implements now found the ruder belongs to the latter race. It has been a debated question whether the civilization of the cave man was the outcome of the development of that of the river-drift man. The evidence seems to indicate that they must be classed either as two distinct races or as two sections of the same race, which found their way into Europe at widely different times—the river-drift men being of far greater antiquity in Europe than the others. The discoveries of late years tend to confirm the identification of the cave men with the Esquimaux. We infer that the cave men clothed themselves with skins, for instruments for dressing skins are found precisely like those now employed for that purpose by the Esquimaux. That they wore gloves is shown by carvings which represent them, and there is reason to believe that they were in the habit of decorating their persons in various ways. The art of representing wild animals in carvings and by sculpture was carried to a high stage of excellence by the cave-dwellers, and it is doubtful if an artist of the present time could do better work, or even as good, with the rude instruments used by them. One of the most interesting examples of their skill is shown by representation of a mammoth, and we know that the extinct creature is faithfully portrayed, because its remains have come down to us perfectly preserved in the ice of the northern latitudes. In various ways the habits of the cave men correspond to those which now prevail among the Esquimaux.

## NATURAL SELECTION.

A curious instance has occurred showing the difficulty of explaining the true theory of "Natural Selection," even to scientific men; it is therefore not surprising to find that those who are opposed to the principle from religious motives, fail to realize what is understood by the term. In a letter to *Nature*, Mr. Charles Darwin states he is sorry to find Sir Wyville Thompson does not understand this principle of natural selection as explained by himself and Dr. Wallace, as, if he had done so, he would not have wrtten a sentence found in his introduction to the voyage of the *Challenger*, as follows; "The character of the abyssal fauna refuses to give the least support to the theory which refers to the evolution of species to extreme variation, guided only by natural selection." This, says Mr, Darwin, is a standard of criticism not uncommonly reached by theologians and metaphysicians, when they write on scientific subjects, and asks, "can Sir Wyville Thompson name any one who has said that the evolution of species depends only on natural selection?" and continues, "as far as concerns myself, I believe no one has brought forward so many observations on the effect of the use and disuse of parts, as I have done in my 'Variations of Animals and Plants under Domestication,' and those observations were made for that special object. I have also there adduced a considerable body of facts, showing the direct action of external conditions on organisms, though, no doubt, since my books were published, much has been learnt on this head."

## PROPAGATION OF SOUND BY LIGHT IN 1811.

In searching a volume, dated 1811, for papers relating to the introduction of illuminating gas, we noticed a paper by Modeste Parolette, entitled "Inquiries Concerning the Influence of Light on the Propagation of Sound," taken from the *Journal de Physique*, Vol. LXVIII.

Although Parolette cannot be said to have anticipated those physical facts, the knowledge of which enabled Edison to design that wonderful instrument, the *Tasimeter*, and since developed by Bell in his *Photophone*, still Parolette seemed to be on the right track.

In opening his subject, Parolette states that the object of his inquiry was the relation which subsists between the action of light and the vibrations of sonorous bodies, and he actually made an instrument for measuring the effect of light on sound-vibrations, and called it the *Phonometer*.

Parolette's experiments were rude compared with those of more recent date, but it most be remembered that they were made seventy years ago. He used no mirrors for concentrating a beam of light, but relied merely on the natural properties of light without such aids. He says, "As it is known that the vibrations of elastic fluids are always analogous to those of the particles of the sounding body, and that if two strings, belonging to two instruments, be in unison, when one is touched the other will vibrate and emit a perceptible sound; I availed myself of these properties in the construction of my apparatus, and in determining the object of my inquiry.

The *Phonometer* consisted of two violins placed on a horizontal plank ten feet long and eight inches wide. Having tuned these instruments to the Paris diapason, he fixed a piece of paper to the second string of one of them to

serve as an index during the course of his experiment—one violin being fixed and the other moving in a grooved sliding rest. The second string was then vibrated in a uniform manner, which produced an oscillatory motion, which was heard on the corresponding string of the other violin. The paper on the string showed the vibration at a distance, and the violins were separated from each other until the agitation of the paper ceased. This point was marked as the limit of the vibrations and marked 100, the intermediate portion being marked off to represent the one thousandth part of the distance.

Experiments made at noon with this instrument, and often repeated, indicated the same distance within a few thousandths. The whole extent of the scale was seven feet, and this distance was the limit of the greatest propagation of sound under the influence of light in the apparatus. Parolette further states that experiments in darkness gave, as a result, a mean temperature of 0.98, and that the mean difference of this propogation at noon and midnight was two degrees on the scale. In conclusion, Parolette tries to explain the results arrived at by stating that during the day, the atmosphere is more nearly saturated with oxygen than in the night, but he says it remains to be proved that this excess is sufficient to cause such a difference in the propagation of sound during the two periods. and adds, "rather, may not light be the true cause of this increased propagation in oxygen and nitrous gas; as it is known that the former has a great capacity for light, and the latter cannot be formed without its presence." As the velocity of light is 900,000 times greater than that of sound, it does not appear unreasonable to explain, in this way, its effects on the vibrations which proceed from sonorous bodies. J. M.

## THE NATIONAL ACADEMY OF SCIENCES.

As the meeting held on the 16th of November last, and those of the three following days, were devoted to the reading of scientific papers only, little executive business was transacted and no new members were elected.

At the meeting of the Council the following deaths of members were announced:

J. Homer Lane, of Washington, in May. S. S. Haldeman, of Chickies, Pa., in September, and Count L. S. Portalès, of Cambridge, Mass., in October.

The decease of Professor Benjamin Peirce, of Harvard College, one of the original active members of the Academy, but whose connection with it had been severed, was also announced.

Resolutions, thanking the Trustees of Columbia College for providing rooms for the meeting, and to President Barnard and officers of the college and other members of the Academy in New York for liberal entertainment of its members, were adopted.

THE FOLLOWING PAPERS WERE PRESENTED:

1. On the Basin of the Gulf of Mexico.—J. E. Hilgard.
2. On the Origin of the Coral Reefs of the Yucatan and Florida Banks.—Alexander Agassiz.
3. Observations on Ice and Icebergs in the Polar Regions.—F. Schwatka.
4. On the Duration of the Arctic Winter.—F. Schwatka.
5. Mineralogical Notes.—Benjamin Silliman.
6. The Relationship of the Carboniferous Euphoberia to living and extinct Myriapods.—Samuel H. Scudder.
7. Report on the Dredging Cruise of the U. S. Steamer *Blake*, Commander Bartlett, during the Summer of 1880.—Alexander Agassiz.
8. On Some Recent Experiments in Determining the Electro Motive Force of the Brush Dynamo-electric Lamps operating by Incandescence.—Henry Morton.
9. On the Intimate Structure of certain Mineral Veins.—Benjamin Silliman.
10. On the Ellipticity of the Earth as Deduced from Pendulum Experiments.—C. S. Peirce.
11. On an Improvement in the Sprengel Air Pump.—O. N. Rood.
12. On the Thermal Balance.—S. P. Langley.
13. On the Measurment of Radiant Energy.—S. P. Langley.
14. Causes which Determine the Progressive Movements of Storms.—Elias Loomis.
15. On the Antimony Mines of Southern Utah.—J. S. Newberry.
16. On the Conglomerate Ore Deposits of the United States and Mexico.—J. S. Newberry.
17. On Photographing the Nebula in Orion.—Henry Draper.
18. On Condensers for Currents of High Potential.—George F. Barker.
19. On Sigsbee's Gravitating Trap.—Alexander Agassiz.
20. On the Deposits of Crystalline Iron Ores of Utah.—J. S. Newberry.
21. On the Origin of Anthracite.—T. Sterry Hunt.
22. On the Star-List of Abul Hassan.—C. H. F. Peters.
23. Dimensions of the Brain and Spinal Cord in some extinct Reptiles.—O. C. Marsh.
24. On the Rimravidæ.—E. D. Cope.
25. On the Miocene Canidæ.—E. D. Cope.
26. On a New General Method in Analysis.—Wolcott Gibbs.
27. Note on the Relations of the Oneonta and Montrose Sandstones with the Sandstones of the Catskill Mountains.—James Hall.

## ON THE MEASUREMENT OF RADIANT ENERGY.*

BY PROF. S. P. LANGLEY.

Sir William Herschel showed that a thermometer indicated more heat beyond the darkest red of the spectrum of a prism than in the brightest part of the color; therefore, he concluded that light and heat were essentially different things. This view has apparently been confirmed by numerous other European experiments, and has been set forth in all but the most recent text-books, where different curves are drawn to exhibit the light and the heat of the sun. Of late years many leading minds have recognized that these were only different manifestations of radiant energy. Prominent among these is Dr. John W. Draper, who asserted this principle long ago, and who has always maintained that if the heat in a pure diffraction spectrum could be accurately measured, its distribution would be found almost identical with that of light. This was an experiment, which, however, could never have been satisfactorily performed had it not been for the skill of Lewis M. Rutherfurd, Esq., of this city, who has made at his private expense the exquisitely delicate apparatus which can produce pure spectra, with a success far greater than any attained by the most skillful professional artisans of Europe.

By the use of one of these "gratings," made on Mr. Rutherford's engine by Chapman, and the employment of the thermal balance described in another paper, I succeeded in obtaining for the first time full and exact measurements of the distribution of energy in a pure spectrum, where no lens or prism had been used, and of fixing its relative amount, as determined accurately by the wave-lengths of light in all parts of the visible spectrum and in the ultra red. It remained to make some minute corrections for the selective absorbtions of the reflecting apparatus employed. The essential result, however, is of high theoretical interest; it is, that heat and light as received from the sun are now experimentally proved, so far as such measurements can prove it, to be in essence the same thing. The old delineations of

* Read before the National Academy of Sciences, N. Y., 1880.

essentially different curves representing heat and light must be banished hereafter from text-books. The old views on this subject can no longer be maintained even by European men of science, who are prepossessed in their favor. This result, fulfilling what was almost a prophecy when made, a quarter of a century ago, by the elder Draper, and, being due largely to means which science owes to Mr. Rutherfurd, may, if obtained, be most fairly claimed as largely due to the two Americans whose names have just been cited.

## ON THE INTIMATE STRUCTURE OF CERTAIN MINERAL VEINS.*

PROF. BENJAMIN SILLIMAN.

Dr. Sorby, of England, in his classical paper "On the Cavities and Fluidal Inclusions found in Certain Varieties of Quartz," made the sagacious suggestion that certain fluidal inclusions observed by him in quartz consisted of two fluids, viz., water and probably a liquified gas also. An examination has recently been made of a remarkable vein stone from a gold vein nown as "Hunter's Rest," Arizona. This vein was capped by a black uncrystalline rock resembling somewhat hornblend in a compact form. But it was seen under the microscope with polarized light to be compact tourmaline, a mineral never found associated with gold. This black rock which is common enough in connection with tin ore, is here abundantly coated with gold. But beneath this black capping at a very moderate depth, occurs the usual quartz filling of gold-bearing veins—the quartz in this vein showing free gold in brilliant points, and stains of copper green with some pyrite, galena, etc. This quartz seen in thin section under a high power, showed a multitude of fluidal cavities, and among them were some which under a high power (⅛ to 1-15-inch) showed distinctly two fluids, one of which existed as an inner bubble, and which displayed almost constant activity of motion. This second liquid was liquified carbonic acid. Thin sections of the vein-stone were placed upon a slide for examination. When warmed, the carbonic acid expanded and the motion ceased, bnt when permitted to become cold, it became as active as before. Quartz with gold found in Southern California near the Nevada line, is entirely destitute of sulphurets, showing that the intervention of iron salts as a solvent agent was not necessary in the formation of the deposits of gold.

## THE TURQUOISE OF NEW MEXICO.*

PROF. BENJAMIN SILLIMAN.

A number of domestic articles have recently been found in excavations at Mount Chalchuitl, in Los Cerillos, about twenty-two miles southwest of the ancient town of Santa Fe. Among these are a large stone hammer of the hard hornblendic Andalusite of which the mountains of the country are largely formed; a lamp, a pottery idol, such as are manufactured to this day; a spoon made of shell; a perpect specimen of a pottery dish, and some of the bones of the Pueblos or Indian miners, who were killed in 1680 by the fall of a large section of Mt. Chalchuitl, which had been undermined by them. These articles had been covered in the caverns for 200 years when found. The rocks which form Mt. Chalchuitl—the Indian name of the turquoise—are distinguished from those of the surrounding and associated ranges of the Cerillos by their white color and decomposed appearance, closely resembling tuff and kaolin, and giving evidence of an extensive and profound alteration, due, probably, to the escape through them, at this point, of heated vapor of water and perhaps of other vapors or gases, by the action of which the original crystalline structure of the mass has been completely decomposed or metamorphosed, with the production of new chemical compounds. Among these the turquoise is the most conspicuous and important. In the seams and cavities of this yellowish-white and kaolin-like tuffaceous rock the torquoise is found in thin veinlets and little balls or concretions called "nuggets," covered on the exterior with a crust of the nearly white tuff, and showing on cross fracture the less valued varieties of the gem, more rarely offering fine sky-blue stones of higher value for ornamental purposes. It is easy to see these blue stains in every direction among these decomposed rocks, but the turquoise in masses of any commercial value is extremely rare, and many tons of the rock may be broken without finding a single stone which a jeweller or virtuoso would value as a gem.

That considerable quantities of the turquoise were obtained can hardly be questioned. The ancient Mexicans attached great value to this ornamental stone, as the Indians do to this day. The familiar tale of the gift of large and costly turquoise by Montezuma to Cortez for the Spanish crown, as narrated by Clavigero in his history of Mexico, shows the high value attached to this gem. It is not known that any other locality in America has furnished turquoise in any quantity. The origin of the turquoise of Los Cerillos in view of late observations is not doubtful. Chemically, it is a hydrous aluminum phosphate. Its blue color is due to a variable quantity of copper oxide derived from associated rocks. The Cerillos turquoise contains 3.81 per cent. of this metal, Neglecting this constituent the formula for turquoise requires: phosphoric acid, 32.6; alumina, 47.0; water, 20.5. Total, 100.1. Evidently the decomposition of the feldspar of the trachyte has furnished the alumina, while the phosphate of lime, which the microscope detects in the thin sections of the Cerillos rocks, has furnished the phosphoric acid. A little copper is diffused as a constituent also of the veins of this region, and hence the color which the metal imparts. The inspection of thin sections of turquoise by the microscope, with a high power, shows the seemingly homogeneous mass of this compact and non-crystalline mineral to consist of very minute scales, nearly colorless, and having an aggregate polarization, and showing a few particles of iron oxide. The rocks in which the turquoise occurs are seen by the aid of the microscope and polarized light in thin section to be plainly only the ruins, as it were, of crystalline trachytes showing remnants of feldspar crystals, decomposed in part into a white kaolin-like substance, with mica, slag and glassy grains, quartz, with large fluidal inclosures, looking like a secondary product. There is a considerable diversity in their looks, but they may all be classed as trachyte-tuffs, and are doubtless merely the result of the crystalline rocks of the district along the line of volcanic fissures.

## ON A NEW GENERAL METHOD OF ANALYSIS.*

BY PROF. WALCOTT GIBBS.

The process consists essentially in passing a galvanic current through the solution in such a manner that a surface of metallic mercury forms the cathode, and a plate of platinum the anode. Under these circumstances the metal in the solution combines with the mercury to form an amalgam. What is new in this process is the fact that a number of metals, as for example, iron, cobalt, nickel, zinc, cadmium, tin, mercury, etc., may be *completely* removed from the solution so that the electro-negative constituent of the roll may be determined in the solution by ordinary methods, while the metal itself is found by the increase in weight of the mercury. The extent of the applications of the method and its limitations remain to be determined.

* Read before the National Academy of Sciences, N. Y., 1880.

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## NOTE UPON THE RELATIONS OF THE ONEONTA AND MONTROSE SANDSTONES OF VANUXEM, AND THEIR RELATION TO THE SANDSTONES OF THE CATSKILL MOUNTAINS.*

By Prof. James Hall.

Great difficulty has been experienced, from the time of the New-York Geological Survey, in reconciling the observations made upon these sandstones in their various localities. Mr. Vanuxem indicated the upper formation of the third geological district as the "Montrose sandstone, or sandstone of Oneonta," and described it as occurring in Otsego, Chenango and Broome counties, New York, and as covering the whole of the upper part of Susquehanna county in Pennsylvania. Oneonta, Gilbertsville and Mount Upton were regarded as typical localities, the latter affording remains of both animals and plants. Mr. Mather described the "Catskill Mountain series" as occupying the county of Delaware and the greater part of the counties of Sullivan, Ulster, Greene and Schoharie; but in this description he included the olive slates and shales above the Helderberg series, which have since been separated as the Hamilton and Chemung groups. In the final arrangement of the nomenclature of these rocks, the observations of Mr. Mather in Delaware and Ulster counties led to the adoption of the term Catskill sandstone, or Catskill Mountain sandstone, for the whole, including the Oneonta and Montrose sandstones of Vanuxem, under the belief that the rocks as exposed in the several localities constituted parts of, or different exposure of, a single formation. This view has been accepted in all subsequently published observations, and universally believed to be the true one.

My first observations in this part of the country, previously to 1870, were made in 1844, but at that time only for the collection of fossils. In 1863 I made a section across the formations from Schoharie to Oneonta and thence to Franklin and to the South-westward of that town, and across the country to Delhi in Delaware county, returning to Schoharie by a more Eastern route. The results proved unsatisfactory from the fact that crossing from Oneonta and approaching Franklin over red and mottled shales and sandstones with an apparently southwest dip, these were succeeded by gray and greenish shales and sandstones carrying Chemung fossils; and again, on the road to Delhi, these latter were succeeded by red rocks.

Although, in the mean time having visited Montrose and some other localities of these sandstones, it was not until 1869 and 1870 that I was able to give any special attention to the relations of these formations on the Western slope of the Catskills, in the towns of Oneonta, Guilford, Sidney Plains and the adjacent country, still finding myself quite unable to parallelize the formations as there existing, with the sandstone of the Catskills. In the latter year Mr. George B. Simpson and Dr. J. W. Hall were employed in this region, and directed to make cross sections of the country in different directions; and their observations, after having reviewed the principal localities in company with myself, gave the same result, viz.: that the extensive formation of red and greenish mottled shaly sandstones, with brownish red and gray diagonally laminated sandstone, in the localities of Oneonta and Mount Upton and other places in the same region, were succeeded by sandstones and arenaceous and argillaceous shales, carrying great numbers of marine fossils known as belonging to the Chemung group, together with some bones and teeth of fishes of a peculiar character. To the latter again succeeded red and greenish gray or brownish gray beds, which in one locality in the town of Andes had already furnished scales of *Holoptychius*, and a nearly entire specimen of that fossil fish.

Notwithstanding the clearly ascertained order of succession among the members of the higher formations of the State, I have hesitated to publish results in opposition to the conclusions of my former colleagues, believing that I might possibly have been mistaken in my interpretations of the geological structure of the country.

About the same time, I employed Mr. Andrew Sherwood to work out the geological structure of the Catskill mountain region, and in 1875, after four years of investigation, I was able to present to the American Association for the Advancement of Science, and subsequently to the Academy, a large geological map, showing the general structural features of the Catskill region. In this work upon the structural character, in regard to the anticlinal and synclinal arrangement of the strata, the question of a subdivision of the formation has not been presented; and it was only in the present year, 1880, that Mr. Sherwood was again employed to complete investigation for a final geological map. In this work it became necessary to review the section along the Schoharie creek, which had previously been left at the commencement of the red rocks; and also of the country about Oneonta, Mount Upton, Guilford, Sidney Plains and Franklin.

The result of these observations has been entirely confirmatory of the results brought out by Messrs. Simpson and Hall in 1870. In accordance with our present knowledge therefore, we are compelled to adopt the view that the red and gray rocks of Oneonta and Mount Upton, beginning at the latter locality, with shaly beds containing large numbers of a single fossil species described by Mr. Vanuxem as *Cypricardites Catskillensis* and *C. Augusta*, and supposed to be the equivalent and actual continuation of the Catskill red sandstone of Delaware county, are in fact succeeded by rocks carrying large numbers of Chemung fossils.

The fossil shell described by Mr. Vanuxem has the form and character of an *Anodonta*, and is apparently a fresh water form, and occurs in association with large numbers of fragmentary and drifted land plants. The formation consists of red marls, red and gray sandstones in alternating bands, the whole diagonally stratified, and attaining, in this region, a thickness of at least 500 feet.

The fossiliferous beds of the Chemung are found lying upon that formation between Norwich and Oneonta, and to the east of Sidney plains, and at or near Franklin, where they apparently pass beneath the great red sandstone formation of the Catskills, which is characterized by the presence of bones and scales of *Holoptychius*.

From all these facts it would appear, that some time after the Hamilton period, the open sea was cut off from this area during a long period, that dry land producing abundant vegetation with estuary and fresh water conditions ensued; and that at a later period the subsidence of the coast allowed the influx of the ocean which spread over the area westward, giving beds of shale, sandstone, etc., charged with marine fossils of the Chemung period. That again, the open sea was invaded by an elevation of the littoral line, and then followed the great accumulation of red and greenish marls, brown sandstones and conglomerates, terminating above by a heavy formation of gray sandstone, the whole forming the great mass of the Catskill mountains; and to this formation only should the name of Catskill sandstone be properly applied.

This conclusion, which is sustained by our present knowledge, suggests some very important considerations concerning the relations of the Hamilton, Portage and Chemung groups, which will be discussed at some future time, and which, when investigated under the present phase of our knowledge, may solve some existing problems regarding these formations.

* Read before the National Academy of Sciences, N. Y., 1880.

## AN IMPROVED METHOD OF OPERATING THE SPRENGEL AIR-PUMP.*

By Professor Ogden N. Rood.

Professor Rood's paper gave an account of his experiments with the pump for the purpose of obtaining the highest possible vacua. He first experimented with an arrangement similar to the ordinary form of the Sprengel pump, and reduced the pressure to one three-millionth. The exhaustion went on very rapidly at first and then very slowly—slower than the increased rarefaction seemed to call for. This indicated a leakage, and it was found that this leakage amounted in one minute to one-eighty-seven millionth of an atmosphere. The form of the pump was modified to correct the leakage, and a vacuum was obtained with a pressure of one-sixty-millionth. It was impossible to get beyond that point, and it occurred to Professor Rood that the potash he used might have given out moisture. He therefore substituted sodium, and the pressure rose only to one-four-millionth. Anhydrous phosphoric acid was substituted for the sodium, and the pressure fell to one-millionth. It finally struck the experimenter that the trouble was in the gauge, and when a correction was applied to the gauge, vacua were obtained with pressures of one ninety-four-millionth and one-hundred-and-ten-millionth. Higher vacua even can be obtained.

It had recently been stated in *Nature*, said Professor Rood, that his arrangement was exhibited four years ago at the Kensington Garden, and he would not, therefore, call it new. But the best result obtained in England was one-twenty-millionth, and the best result reached by an eminent French chemist was one-seventeen-millionth. He, therefore, thought there must be at least something new in his method of using the Sprengel air-pump.

## REPORT OF THE COMMISSIONER OF EDUCATION, FOR 1878.

(*Extracts.*)

### TEXT-BOOKS AND COURSES OF STUDY.

The lack of uniformity in the conditions of public education in the different States is illustrated in the report on text-books and courses of study.

Returns from 31 States present the following information:

The State board is empowered to decide these matters in California, Connecticut, Delaware, Louisiana, Nevada, and Oregon. In Kansas, Nebraska, New York, and Rhode Island, the State superintendent or commissioner has authority to recommend the text-books to be used, but their adoption and the course of study are finally decided by the school committee or district boards. In Iowa and South Carolina these matters have been decided by a commission appointed for the purpose. In Maine, authority in these matters is delegated to the town supervisor or school committee; in Maryland, to the county commissioners; in Massachusetts, to the school committee; in New Jersey, to school trustees of districts acting with the county superintendents; and in Pennsylvania, to the directors and controllers of each school district, acting with the teachers. District or local boards either solely or acting in concert with superintendents and teachers decide these matters in Michigan, Mississippi, Missouri, Ohio, and Wisconsin.

In the following States—Minnesota, New Hampshire, Tennessee, Texas, Virginia, and West Virginia—the course of study is prescribed by law, but in the application discretion is given to superintendents, local boards, teachers, &c.

In Indiana, North Carolina, and Vermont no definite provision with reference to these matters has been made.

### UNIVERSITIES AND COLLEGES.

The total number of universities and colleges reported is 358, with 3,885 instructors and 57,987 pupils. In the preparatory departments of these institutions were 682 instructors and 26,266 students; in the collegiate departments, 3,203 instructors and 30 368 students: unclassified, 1,353. They had 2,187,932 volumes in their libraries, and the value of their buildings, grounds, and apparatus was $36,871,213; their productive funds, $37,071,958; income from these funds, $2,548,324; receipts from tuition, $1,555,484; receipts from State appropriations, $622,577; aggregate amount of scholarship funds, $1,719,426.

Of the students in the preparatory departments, 18,481 are males and 6779 females; 6,576 are preparing for a classical course and 5,621 for a scientific course. In the collegiate departments, 15,803 (14,152 males and 1,651 females) are in classical course, and 3,893 (2,724 males and 1,169 females) are in scientific course.

The summary of college entrance examinations gives the following facts: Total number of candidates, 5,297; admitted without conditions, 2,553; conditioned in Latin, 822; in Greek, 577; in mathematics, 1,068; in history and geography, 585; rejected for deficiency in Latin, 84; in Greek, 70; in mathematics, 66; in history and geography, 22; in two or more subjects of examination, 424.

There are also statements of the numbers preparing for college, classical, and scientific courses, as follows: number preparing for classical course in academies, 6,206; in preparatory schools, 4,195; in universities and colleges, 6,576; preparing for scientific course: in academies, 2,167; in preparatory schools, 1,107; in universities and colleges, 5,621; in preparatory departments of scientific schools, 1,550; total, 27,422.

Students in institutions for superior instruction are distributed thus, viz.: in colleges, 30,368; in schools of science, 11,603; in schools for the superior instruction of women, 18,115; in all 60,086.

The Commissioner presents a brief outline of the movement in colleges to satisfy the demand that the study of science and sociology be advanced to an equality with the classics and mathematics. Without sacrificing anything of the former curriculum, temporary provision for the new studies has been made in most instances by a system of electives. The action is traced through the record of Harvard and Yale Colleges, and the views of Dr. McCosh, president of Princeton College, Dr. Peabody, of Harvard University, and Prof. B. L. Gildersleeve, of Johns Hopkins University, with reference to the most important conditions of the charge, are cited.

Some have feared that in this readjustment of college courses the classics would be sacrificed, but the present tendency is toward greater thoroughness and a more extended range in classical studies; nor under the elective system is the number of students who take the modern in place of the classical course sufficiently large to create any apprehension as to the future influence of classical study.

The prevalent views on this subject are well represented in letters from Professor Hæckel of Jena and Professor Zarncke of Leipzig, which are given in full in the report.

### SCHOOLS OF SCIENCE.

Of this class 76 schools, including the United States Naval and Military Academies, were reported to the Bureau. They numbered 809 instructors and 13,153 students. The comparative table for the years from 1870 to 1878, inclusive, shows this to be an increase in all particulars over the figures reported for any previous year. The increase above 1877 was in number of schools, 2; instructors, 28; students, 4,594. The number of students in preparatory departments was 1,436, viz.: 1,153 males and 283 females; the number in scientific departments was in regular course, 4,806; in partial course, 772; number of graduate students, 97. The number of volumes in general libraries was 119,164, an increase in the last school year of 3,543; the number in society libraries was 7,737. The value of grounds, buildings, and apparatus reported, was $7,587,421; productive funds, $5,020,446; income from the same, $319,503; receipts from tuition fees, $68,660; from State appropriations, $484,742.

With reference to schools of science the Commissioner observes:

"By the act of 1862 donating public lands to the several States and Territories which should provide colleges for the benefit of agriculture and the mechanic arts, the movement

* Read before the National Academy of Sciences, N. Y., 1880.

toward scientific training became national, the prospective institutions were sufficiently endowed for the initiatory stages, and each was free to suit its organization to the wants of its locality; the scientific schools previously established had been organized and developed in accordance with strict scientific principles, and their example afforded a powerful opposition to the influences which tended to hold the new schools to a lifeless routine of mechanical exercises on the one hand or to a feeble modification of the methods of classical colleges on the other. The reports of the year indicate that the future of these institutions as schools of applied science, conducted according to the laws of intellectual progress and directed 'to the liberal and practical education of the industrial classes' is assured, and that in the main the character of each school is to be determined by the material condition of the section in which it is placed. Thus, in the East, the tendency is to the training of engineers and scientific experts; in the great agricultural section of the West and South, agriculture and horticulture receive most attention; while in the mineral region of the Pacific section mining and metallurgy are made prominent; but even where these special tendencies are marked, other branches of scientific and industrial instruction have received attention proportionate to the demand."

Interesting facts are presented illustrating the practical advantage of these institutions to our industrial progress. The Commissioner adds that there has been marked advance in the general organization of these schools and in their preparation for efficient work in science and mechanics.

SCHOOLS OF MEDICINE.

The number of schools of medicine, dentistry, and pharmacy reported to the Bureau during the year was 106. These had 1,337 instructors and 11,830 students. The regular school of medicine and surgery reported 64 institutions, 915 instructors, 8,279 students, 2,506 graduates, 46,065 volumes in libraries, $1,685,250 in grounds, buildings, and apparatus, $214,347 of productive funds, yielding an income of $13,186, and tuition receipts to the amount of $289,398. The eclectics reported 6 institutions, 51 instructors, 448 students, 211 graduates, 3,000 volumes in libraries, $161,000 in grounds, buildings, and apparatus, and $8,960 receipts from tuition. The homœopathists reported 11 schools, 158 instructors, 1,215 students, 363 graduates, 39,800 volumes in libraries, $349,000 in grounds, buildings, and apparatus, and $95,471 receipts from tuition fees.

The dental schools report as follows: number, 12; instructors, 161; students, 701; graduates, 218; volumes in libraries, 505; value of grounds, buildings, and apparatus, $68,000; receipts from tuition fees, $60,734.

The pharmaceutical schools number 13; instructors, 52; students, 1,187; graduates, 380; volumes in libraries, 5,175; value of grounds, buildings and apparatus, $155,000; receipts from tuition fees, $25,487.

COLLEGIATE AND PROFESSIONAL DEGREES.

"This Office," says the Commissioner, "is informed that the better colleges and universities of the country are becoming increasingly careful in the bestowal of honorary degrees. At the same time it is well known that the sale of diplomas by persons who have obtained control of collegiate and university charters by purchase or fraud is still going on. This disgraceful proceeding has already injured the reputation of American learning and the value of American degrees in other countries; but the Federal Government did not create the corporations which are causing this scandal and has no power to cancel their charters. It is for the authorities of the State to move in the matter and thus vindicate the honor of the nation and of American scholars."

The following summary of degrees in course and honorary conferred by reputable institutions of learning needs no further explanation:

The number of degrees of all classes conferred was, in course, 9,999, honorary, 396, divided as follows: letters, in course, 3,631, honorary, 114; science, in course, 990, honorary, 6; philosophy, in course, 222, honorary, 31; art, in course, 46; theology, in course, 222, honorary, 159; medicine, in course, 3,814, honorary, 4; law, in course, 1,000, honorary, 78. Of these degrees, classical and scientific colleges conferred 6,367 in course and 388 honorary; colleges for women, 674 in course and 1 honorary; professional schools, 2,958 in course and 7 honorary.

EDUCATIONAL BENEFACTIONS.

The total amount of educational benefactions is $3,103,289, which is distributed as follows: universities, and colleges, $1,389,633; schools of science, $49,280; schools of theology, $397,852; schools of law, $100,000; schools of medicine, $18,562; institutions for the superior instruction of women, $241,820; preparatory schools, $97,191; institutions for secondary instruction, $759,817; institutions for the deaf and dumb, $49,134.

## EDUCATIONAL BENEFACTIONS.

During the year 1878 the sum of $3,103,298 was presented to various educational establishments in the United States by private individuals.

Of this sum $1,389,633 were placed at the disposal of universities and colleges. We regret to find that while Theology received nearly $400,000, but $49,280 were devoted to Science, and $18,562 to Medicine. Schools of Law received $100,000. The deaf and dumb received about the same amount as Science.

The University of California received $125,000, $25,000 to build a library building, and $50,000 to purchase books. This amount did not include a collection of works of art and a library valued at $50,000.

Yale College received $189,590. Boston University $30,000 towards the purchase of the Shepard Collection of minerals. From various sources Harvard University received $177,207; Dartmouth College, $35,000: Cornell University, $27,663; Union College, N. Y., $84,000; Oberlin College, O., $25,000; University of Virginia, $50,000 to endow School of Geology and Natural History; Wellesley College, $155,000; Thayer Academy, Mass., $417,000; Deerfield Academy, Mass., $88,000; Dean Academy, $38,000.

## PALÆONTOLOGY.

THE DEVONIAN INSECTS OF NEW BRUNSWICK.

In a memoir, on the Insects in the Devonian of New Brunswick, Mr. S. H. Scudder draws the following conclusions in regard to the earliest known insects:

"It only remains to sum up the results of this re-examination of the Devonian Insects, and especially to discuss their relation to later or now existing types. This may best be done by a separate consideration of the following points:

"There is nothing in the structure of these earliest known insects to interfere with a former conclusion that the general type of wing structure has remained unaltered from the earliest times. Three of these six insects (Gerephemera, Homothetus, Xenoneura) have been shown to possess a very peculiar neuration, dissimilar from both Carboniferous and modern types. As will also be shown under the tenth head, the dissimilarity of structure of all the Devonian Insects is much greater than would be anticipated; yet all the features of neuration can be brought into perfect harmony with the system laid down by Heer.

"The earliest insects were Hexapods, and as far as the record goes, preceded in time both Arachnids and Myriapods.

"They were all lower Heterometabola.

"They are all allied or belong to the Neuroptera, using the word in its widest sense.

"Nearly all are synthetic types of comparatively narrow range.

"Nearly all bear marks of affinity to the Carboniferous Palæodictyoptera, either in the reticulated surface of the wing, its longitudinal neuration, or both.

"On the other hand they are often of more and not less complicated structure than most Palæodictyoptera.

"With the exception of the general statement under the fifth head they bear little special relation to Carboniferous forms, having a distinct facies of their own.

"The Devonian Insects were of great size, had membran

ous wings and were probably aquatic in early life. The last statement is simply inferred from the fact that all the modern types most nearly allied to them are now aquatic.

"Some of the Devonian Insects are plainly precursors of existing forms, while others seem to have left no trace. The best examples of the former are Platephemera, an aberrant form of an existing family; and Homothetus which, while totally different in the combination of its characters from anything known among living or fossil insects, is the only Palæozoic insect possessing that peculiar arrangement of veins found at the base of the wings in Odonata typified by the arculus, a structure previously known only as early as the Jurassic. Examples of the latter are Gerephemera, which has a multiplicity of simple parallel veins next the costal margin of the wing, such as no other insect ancient or modern is known to possess; and Xenoneura, were the relationship of the internomedian branches to each other and to the rest of the wing is altogether abnormal.

"If, too, the concentric ridges, formerly interpreted by me as possibly representing a stridulating organ, should eventually be proved an actual part of the wing, we should have here a structure which has never since been repeated even in any modified form.

"They show a remarkable variety of structure, indicating an abundance of insect life at that epoch.

"The Devonian Insects also differ remarkably from all other known types, ancient or modern; and some of them appear to be even more complicated than their nearest living allies.

"We appear, therefore, to be no nearer the beginning of things in the Devonian epoch than in the Carboniferous, so far as either greater unity or simplicity of structure is concerned; and these earlier forms cannot be used to any better advantage than the Carboniferous types in support of any special theory of the origin of insects.

"Finally, while there are some forms which, to some degree, bear out expectations based on the general derivative hypothesis of structural development, there are quite as many which are altogether unexpected, and cannot be explained by that theory without involving suppositions for which no facts can at present be adduced."

## MICROSCOPY.

Mr. W. H. Bullock, of Chicago, the maker of the microscope for lithological work described by us in Vol. I, No. 21 of SCIENCE, writes to us, objecting to an editorial remark, that the arrangement of the polariscope for instant use, claimed as a novelty by Mr. Bullock, had been used in the same position by Swift, of London, for many years.

Mr. Bullock admits the accuracy of this statement, but now sends details, as evidence, that he has shown considerable ingenuity in arranging his analyzing prism, "mounting it in such a manner, that it can be turned round 90 degrees, so that when the lower prism is at the spring stop or zero point, and the upper prism is pushed into position with the indicator forward, the prisms are parallel, and upon its being turned back or revolved 90 degrees the prisms are crossed." "The lower prism is also arranged differently to that used by Swift; it can be fitted either to the sub-stage or used in the supplementary sub-stage, and thus used close under the stage, so that no light can reach the object under observation, except that which passes through the lower prism." Mr. Bullock also notices other improvements which must render the instrument very perfect for the purposes for which it was designed, namely, lithological work.

Mr. Bullock sends a photograph of this microscope and we readily admit that it appears to be an excellent instrument; of the workmanship we are, of course, unable to speak, but probably the reputation of Mr. Bullock is sufficient guarantee in this respect.

NEW YORK ACADEMY OF SCIENCES.—Section of Chemistry.—Monday Evening, December 13, 1880, at 8 o'clock, the following paper, by Dr. HENRY A. MOTT, is announced:—Chemical Decomposition incited by a Cold Fluid Stratum floating on a Warm Liquid.

## ASTRONOMY.

### JUPITER.

MOTION OF SPOTS ON HIS SURFACE.

Jupiter, always enigmatical, has, since the appearance of the great red spot in his Southern hemisphere, become more and more perplexing. It was supposed this object would afford a ready means of determining Jupiter's true period of rotation. It has not done this, but has certainly led to the development of many interesting facts, one of which is that no period can be determined, because there are not two parts of the planet's visible surface which rotate in equal times. It would seem reasonable that any two points on the same parallel of latitude and in the same hemisphere must necessarily rotate with equal velocities; this does not even hold good. Could we be placed in such a position that the rotation of the planet would not visibly change the position of objects on his surface, we should still see the spots moving not only with different velocities, but in contrary directions. Spots very rarely change their latitude, as the very great axial rotation of Jupiter confines their motion to a parallel with his equator. In Jupiter's Southern hemisphere are two or three small dusky oblong spots. The most distinct of these I first observed on the morning of July 25, 1880, (see *English Mechanic*, No. 804, where an engraving showing its position is given). This group of small spots lies on a parallel of latitude about even with the Southern edge of the great red spot. On July 25, the centre of the first observed of the spots preceded the centre of the large spot by 1h. 35m. Since that date the red spot has been observed constantly, and the small one frequently. Up to November 23, thirty-five transits of the great spot across the central meridian, and nine of the smaller have been carefully observed. On November 22, the small spot preceded the greater by 3h. 17m. The interval between their transits having increased 1h. 42m. since July 25. The large spot has moved backward, compared with the direction of rotation, making its transit on November 22 occur 49m. later than on July 25, while the small spot came to its transit 53m. earlier than on July 25, showing that the two are moving with nearly the same velocity, but in opposite directions. The mean daily drift backward of the great spot since July 25 has been 0.40245m, while the forward motion of the small spot has been, during the same period, 0.43948m per day. It will be seen from this that a rotation derived from the small spot would indicate a quicker period than that derived from the large red spot.

From the observations of July 25 and Nov. 22, the great spot rotates in 9h. 55m. 37.065s., and the small one in 9h. 55 m.16.176s. The mean rotation of the two is 9h. 55m. 26.621s. A reduction of all the observations on hand will, doubtless, slightly change these figures. It would be well for observers to watch this small spot, as it may last as long as the large one. If it should continue permanent, it will eventually make the circuit of Jupiter and meet the red spot; this would occur about the middle of February, 1882.

But the motion of these two objects is very slow compared with the rapidly moving black spots which appeared just north of the equatorial belt on the last of October. But as attention has already been called to these remarkable objects by Messrs. Dennett, Williams and Denning, in *English Mechanic*, No. 816, I will not refer to them here, further than to say that they have been observed and sketched as often as the weather would permit since their first appearance. The region occupied by the great equatorial belt is subject to constant and quite rapid change, being filled at times with the most delicately soft plumey forms. Brilliant white spots are not unfrequent in this zone. These bright spots generally appear as intensely white heads, followed by a light, diffused and fainter train. Sometimes this train is composed of light,

tufty balls, resembling cumulous clouds. These white heads are invariably bent or turned, as if slightly doubled

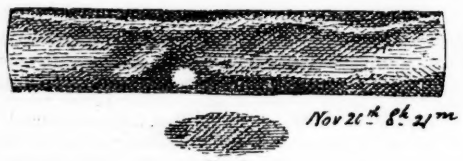


FIG. 1.

under, toward the south, and are generally partially or wholly imbedded in the inner edge of the south portion of the equatorial band. These heads soon become isolated into a regular white spot, the train gradually fading out. All the objects in the equatorial zone move with a very great velocity in the direction of rotation, invariably in a contrary direction to that pursued by the slowly moving red spot, which is really the only object that has a backward motion on the planet. Indeed it would not be a bad comparison were we to compare the red spot to a mighty city built on the shore of a vast and swiftly flowing river, which is constantly being filled with drift, and an occasional glistening mass of ice, tearing its way past the city with a velocity of not less than six thousand

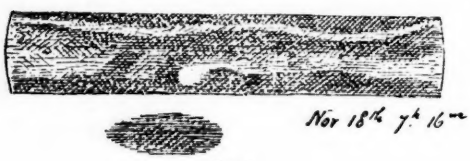


FIG. 2.

miles a day. In such a comparison the city would need be as great in area as three-fourths that of our entire earth, and the river fully sixteen thousand miles in breadth!

One of these swiftly moving bright spots was observed on Nov. 18th (Fig. 1). It had probably existed some few days before that date, but bad weather had prevented observations of the planet.

As it passed very close to the red spot that object afforded a capital means of illustrating its motion.

On the 18th it was situated on a meridian with a part of the red spot about ⅓ its length preceding the following end.

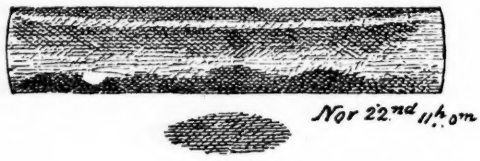


FIG. 3.

This spot was bright with the fainter train following in its wake. On the 20th it was near the preceding end of the red spot (Fig. 2), and had isolated itself more from its train, being partially imbedded in the inner edge of the south band. On the 22d it had left the red spot far behind (Fig. 3), and was smaller and paler, apparently the size of satellite I, then nearing transit. By the 23d it had advanced still further (Fig. 4), and was nearing the west limb when the red spot was central in transit. It was smaller and appeared to vary in brightness.

Bad weather since the 23d has prevented any further observations of this remarkable object.

The pen and ink drawings show the rapid progress of the spot The first sketch was made when the red spot's following end was in transit; the three others when the

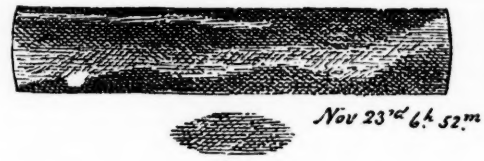


FIG. 4.

spot was central. To save space the sketches only show the great equatorial band and the red spot.

E. E. BARNARD.

Nashville, Tenn., Nov. 29.

## THE NOVEMBER LEONIDS, 1880.

BY EDWIN F. SAWYER.

In the years 1846–47 and 1849, at the November 11–15 epoch, meteors were recorded in considerable numbers, doubtless representing the perihelion passage of a minor cluster of meteors in the cometary-meteor orbit. Last year, both in Europe and America, these meteors were found to be unusually numerous from the 11th to the 15th of November, and the earth probably encountered the minor cluster of 1846 at its return to perihelion. In anticipation that the shower would, this year, at the nodal passage, be of some little intensity, preparations were made for observing the same, but owing to cloudy weather observations could only be obtained on the 11th and 12th; but the indications, at these early dates, were that a large number of shooting stars would be recorded on the 13–14th, and as observed elsewhere such proved to be the case. At Cambridgeport on the 11th, during a two hours watch, from 14h. 30m. to 16h. 30m., 14 meteors were recorded, of which 6 were Leonids. On the 12th, during an hours watch only, from 16¼h. to 17¼h., in a sky more than half overcast, 6 others were noted, equal to at least 15 Leonids per hour for one observer in a clear sky. At the Haverford College Observatory, Penn., Mr. Isaac Sharples, assisted by three other observers, recorded 52 meteors in about an hours watch on the 13th from 3h. 30m. to 4h. 20m., of which 28 were Leonids. Mr. Sharples says, that at the end of the watch, when the sky become overcast, meteors were falling at the rate of two a minute and promised much.

From W. F. Dunning, Esq., F. R. A. S., we learn that the weather was generally unfavorable for observing purposes in England at the November epoch, so that the observations as recorded in this country have a special value, being, so far as heard from, the only ones obtained during the dates on which the Leonid shower is in play. As in the year 1849, meteors were also numerous at this epoch, we may expect a return of the Leonids as a minor shower during the next two years.

Cambridgeport, Dec. 5, 1880.

## LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.*]

### THE WHITE SPOT ON JUPITER.

*To the Editor of* SCIENCE:

The white spot seen passing the great red spot on November 18, 20, etc., and situated on the inner edge of the south equatorial band, was observed again on December 2, the first night for observing since November 23. The white spot was in mid-transit some time

before the red spot had begun to appear at the east limb. It has kept up its rapid motion with probably no particular change in appearance.

From the observed transits of November 22 and December 2, its rotation period is 9h. 50m. 19.4s. It gains 5 m. 18 s. on the red spot at each rotation, or 12 m. 48 s. per day. Should this spot continue permanent for one month longer it will have made the circuit of Jupiter and again be seen passing the great red spot on the night of January 4. On that night the white and red spots will transit together at 11 h. 39 m.

E. E. BARNARD.

NASHVILLE, TENN., *December* 6.

*To the Editor of* SCIENCE:

Last night I viewed Swift's Comet, and found that the Ephemeris computed by Mr. Upton, of the Naval Observatory, Washington, answered quite closely, and was from note book as follows:

SWIFT'S COMET.

Northfield, Minn., Mean Time, 10h. 52m.
R. A. 3h. 32m.
Dec. 51° 28'.

The Comet was well seen, having about the brightness of a seventh magnitude star. Our clock refractor, of aperture of 8¼ inches, was used with power of 50.

Latitude of Observatory, 44° 27' 40.77". Longitude from Washington, 1h. 4m. 23.02s., which has been recently determined telegraphically by aid officers of the Coast Survey. Respectfully yours,

WM. W. PAYNE.

NORTHFIELD, MINN., Dec. 2, 1880.

ASTRONOMICAL MEMORANDA.—(Approximately computed for Washington, D. C., December 13, 1880):

| | H. | M. | S. |
|---|---|---|---|
| Sidereal time of Mean Noon | 17 | 31 | 2 |
| Equation of time | | 5 | 14 |

mean noon *following* apparent time.

The *Moon's* phases for the month are:

| | D. | H. | M. | | D. | H. | M. |
|---|---|---|---|---|---|---|---|
| New Moon | 1 | 9 | 48 | First Quarter | 8 | 1 | 30 |
| Full Moon | 15 | 22 | 28 | Last Quarter | 24 | 1 | 49 |
| New Moon | 30 | 20 | 48 | | | | |

We have the somewhat unusual occurrence of two new moons in the month, and both of them cause partial eclipses of the sun. The eclipse of the first was invisible in the United States; that on the morning of the thirty-first is partially visible. The sun rises eclipsed and remains so until a little after nine o'clock, nearly three-quarters of its disk being covered at the time of greatest obscuration. In addition to these solar eclipses there will be a total eclipse of the moon December 15–16, invisible in the United States, but visible in Central Asia.

*Mercury* may be seen during the week rising about an hour before the sun, and 5° farther north.

*Venus* now crosses the meridian nearly three hours after the sun, and is steadily growing brighter as she approaches the earth.

*Mars* has reached a sufficiently great distance from the sun to be readily seen about an hour before sunrise close to the eastern horizon. It is 2° farther north than the sun, and is easily recognized by its red color. Mars and Mercury are in conjunction on the 23d.

*Jupiter* and *Saturn* have changed but little their relative positions, Saturn crossing the meridian at 7h. 53m., a few minutes after Jupiter. The brilliant markings upon Jupiter's belt have been attracting universal attention.

*Uranus*, crossing the meridian about 5 o'clock in the morning, is in R. A. 11h. 1m. 26s. decl. + 7° 6.2'.

*Neptune* rises about midnight and reaches the meridian at 9 o'clock, at an altitude of 48°.

The Great Nebula in Orion situated around the small quadruple star θ Orionis (the central one of three stars which form Orion's sword-hilt) will be found of great interest to all possessing good telescopes. It rises at 6 P. M., and is just visible as a nebulous mass to the naked eye.

In a communication to the Colorado Academy of Science, Prof. George Davidson, of the U. S. Coast and Geodetic Survey, has placed upon record the somewhat unusual occurrence of a naked eye observation of one of Jupiter's satellites. The station was Monticello, overlooking the Sacramento Valley, 3,125 feet above the sea level. Jupiter, at an elevation of 8°, was slowly rising through a smoky atmosphere, without the least radiation. The third satellite was noticed first by Prof. Davidson, below the disk and somewhat to the left, and was readily seen by four other persons, when attention was called to the phenomenon. Its position was afterwards confirmed by the aid of a field-glass. The satellite remained visible for about twenty minutes, and was finally rendered invisible by the moonlight. On subsequent nights with much clearer sky and no moon, no satellites could be made out with certainty by the unassisted eye.

There is a very ingenius instrument in use at the Greenwich Observatory to record automatically the duration of sunshine through the day. It consists of a glass globe hung within a hemispherical cup of slightly greater diameter. This cup is lined with a strip of paper covered with stencil ink. While the sun is shining, the globe, which is entirely exposed upon the roof, acts as a burning glass, and causes a continuous line to be made upon the paper. This line will be broken, however, as often as the sun's light is obscured by clouds, and thus a determination of the amount of sunshine for the day will be obtained.

M. Martin is engaged in polishing the object glass of the large refracting telescope now building at the Paris Observatory. The diameter of this exceptional lens is 73 centimetres, and its weight 200 kilograms. The quality of the glass having proved defective, it has already broken twice, and the operation is now being made on the third casting. —*Nature.*

We learn from *Nature* that Prof. Bell, together with M. Janssen has been making some experiments at Meudon, upon the application of the photophone to the study of sounds which occur on the sun's surface. "A solar image 0.65m. in diameter" was explored with the selenium cylinder, but no very marked results were obtained.

Schmidt calls the attention of observers to a sharp black spot in the northern part of Jupiter's belt, which gives a time of rotation=9h. 55m., while the heavy white clouds in the middle of the belt give 9h. 50m.

W. C. W.

WASHINGTON, D. C., December 8, 1880.

A new optical milk test has been invented by Messrs. Mittelstrap, Magdeburg. A given quantity of milk, and also of water is examined by looking through different thicknesses until opacity is reached. The vessel holding the liquid has a glass bottom, and in its cover a vertical graduated tube in a slide, with glass closing its lower end. Light is thrown up from below by means of an oblique mirror, or from a direct source. The tube (through which one looks) is moved in the slide until the light disappears, and at this point the scale is read off. Professor Maercker has made experiments with this apparatus, and states it to be very accurate; the greatest difference between the determination of fat in milk, with it, and by chemical analysis, being an average of 0.1 per cent. The usefulness of the instrument applies only to fresh milk, and for skim-milk a special tube is prepared.

## BOOKS RECEIVED.

A GENERAL DESCRIPTION OF THE STATE OF INDIANA, extracted from the First Annual Report of the Bureau of Statistics and Geology for 1879, re-published by authority of his excellency, James D. Williams, Governor.

This is a small pamphlet of 16 pages, containing information of an industrial rather than of scientific character. A map of Indiana is given, the typographical imperfections of which render it a useless addition.

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THE SCIENTIFIC ENGLISH READER. Englisches Naturwissenschafltich-Technisches Lesebuch für höhere technische lehranstalten und zum selfstudium für studirende, lehrer, techniker, industrielle. Mit sprachlichen und sachlichen erläuterungen. Von Dr. F. J. Wershoven: I. Theil—Physik, Chemie, Chemische Technologie, by F. A. Brockhaus, Leipzig, 1881.

This work is intended to place before the German student specimens of the best literary productions of English scientists. The present volume, treating of Physics and Chemistry, gives selections from the works of Lardner, Maxwell, Roscoe, Lockyer, Wilson, Smiles, Grover, Ure, and others who have treated on technical subjects within range of the present work.

To aid those who desire to make translations from this book to the German language, an appendix of German equivalents of English technical words has been given at the end of the work.

Dr. Wershoven's work will also be useful to the English student, "who desires readings in Science." The selections are made with good judgment, and they will be read with profit by those who desire a general idea of English scientific literature, carried well up to date.

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THE STUDENT.—A Monthly Journal devoted to the interests of Education.—Haverford College, Montgomery County, Pa., $1 per annum, 10 cents single number.

The number of periodicals devoted to education is increasing rapidly. "The Student," published by Haverford College, and edited by Professor Isaac Sharpless and Professor Watson W. Dewees, appears to advocate a return to what the editors term old-fashioned studies—classics and mathematics—believing they have made many a sturdy man in the past, and that their influence is as potent for the future as ever. A strictly practical education, meaning such an one as can be directly used in business, the editors consider extremely limited and fruitless of disciplinary value.

If Professor Sharpless has no faith in a "practical education," he appears to believe in making "The Student" a practical educational journal, and we are agreeably surprised to find the subject handled in such an attractive manner.

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GRIFFEN'S CHART OF ANIMAL CLASSIFICATION—adapted to Steele's Zoology. BY A. B. GRIFFEN, 641 Broad street, Newark, N. J. Price, 15 cents.

This Chart shows, in an admirable manner, the relations of the various divisions of the Animal Kingdom. The six great sub-kingdoms, Vertebrata, Articulata, Mollusca, Echinodermata, Coelenterata, are represented as the trunks of as many "Zoological trees," whose branches and twigs are the Classes, Orders, Families, etc. It is of quarto size, and so arranged that it may be folded conveniently and without injury. As a systematic synopsis for convenience of reference we heartily recommend it to the students of Zoology.

## CHEMICAL NOTES.

CHARACTERISTIC DISTINCTIONS BETWEEN HUMAN BLOOD AND THAT OF OTHER ANIMALS.—Dr. Vincenzo Peset y Cervera has found that on mixing the blood of different animals with a little bile there are formed in the mass, crystals not exceeding 0.003 metre in size. These crystals may be distinguished thus:—Those of man are right rectangular prisms; those of the horse, cubes; of the ox, rhombohedrons; of the sheep, rhombohedric tablets; those of the dog, rectangular prisms; those of the rabbit, tetrahedrons; of the squirrel, hexagonal tables; of the mouse, octahedrons; of common poultry, cubes modified at their angles, &c.

ON SOME CAUSES WHICH HINDER OR FACILITATE THE PRECIPITATION OF MANGANESE HYDRATE BY AMMONIA.—Giulio Puliti finds that the precipitation of manganese from its solution by means of ammonia may be partially or totally hindered by sal-ammoniac. Heat renders the sal-ammoniac more efficacious. In hot liquids the precipitation of manganese may be completely prevented if the metal meets with this reagent in the proportion of 1 : 150. He also finds that iron, aluminium, and chromium facilitate the precipitation of manganese.

BEHAVIOR OF CARBONIC ACID WITH NESSLER'S REAGENT AND AMMONIA.—A solution of acid ammonium carbonate or a dilute solution of sal-ammoniac mixed with water containing carbonic acid or with sodium bicarbonate, if mixed drop by drop with Nessler's reagent gives a yellow precipitate, which disappears on agitation without imparting the slightest coloration to the liquid. Not until the free carbonic acid has been saturated by the addition of caustic potassa or of an excess of the reagent, is a permanent yellow coloration produced.—Th. Salzer. *Bul. de la Soc. Chim.*

PERFORATION OF ZINC CISTERNS AND CORROSION OF LEAD PIPES BY WATER.—X. Rocques has observed that the plates of zinc cisterns are corroded, not uniformly, but in certain well-defined places. The cause of this inequality is the electric current, which is set up between the purer portions of the metal and those more alloyed. Zinc, lead, and copper are attacked very slowly by ordinary water and by saline solutions in general (chlorides, bicarbonates). The corrosion is more rapid if there are several metals in contact. The presence of nitrogenous matters and ammonia accelerates the action, especially in case of zinc. The phenomena display their greatest activity in presence of oxygen. This is the case at the surface where the metal is alternately in contact with water and air. The deposits formed are chiefly silicates and carbonates of lead, zinc and copper.

DETECTION OE PICRIC ACID IN BEER.—Dr. H. Fleck evaporates 500 c.c. of the beer to a syrup, mixes with ten times its volume of absolute alcohol, filters off the precipitate, washing it as well as possible, and evaporating the alcoholic filtrate to dryness. The residue is extracted with water at the boiling point as often as the liquid becomes colored, evaporates to dryness, and extracts the residue with ether. The ethereal extract contains the picric acid almost pure.

DETERMINATION OF THEINE IN AEA.—Fifteen grms. tea are repeatedly extracted with boiling water till completely exhausted; the liquid is filtered, evaporated to the consistence of an extract, mixed with 2 grms. calcined magnesia and 5 grms. powdered glass and completely dried.

USE OF BROMINE IN THE ANALYSIS OF SULPHIDES.—Bromine oxidizes sulphur and sulphides very rapidly. Iron pyrites require to be very finely pulverized and a prolonged action is required. Copper pyrites are dissolved very rapidly if an excess of bromine is used, which is easily expelled by a gentle heat. The sample is placed in a small flask, covered with a little water, and the bromine is added. A gentle heat is sometimes necessary towards the end. One part of sulphur requires about 15 parts of bromine. Bromine water is especially adapted for destroying sulphuretted hydrogen and dissolving recently precipitated sulphides.—E. Reichardt.